

Appendix 11

Groundwater Quality

Contents

Appendix 11: Groundwater Quality

1A Groundwater Study Results 2007

Appendix 11A

Groundwater Study Results 2007

Table 11A-1a. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Physical.

Water Quality Station Designator	Date Sampled	Time (PST)	Temp (degrees C)	Temp (degrees F)	pH
Sites Reservoir: Well A	03/24/05	1020	N/A	N/A	7.2
Sites Reservoir: Well B	3/24/2005	1100	N/A	N/A	8.8
Sites Reservoir: Well C	3/24/2005	1130	N/A	N/A	8.8
Sites Reservoir: Well D	3/24/2005	1225	N/A	N/A	7.5
Sites Reservoir: Well F	4/5/2005	0915	N/A	N/A	7.5
Sites Reservoir: Well G	4/5/2005	0935	N/A	N/A	7.5
Sites Reservoir: Well H	4/5/2005	1200	N/A	N/A	7.7
Sites Reservoir: Well I	4/6/2005	1010	N/A	N/A	8.6
Sites Reservoir: Well J	6/7/2005	0900	N/A	N/A	7.4
Sites Reservoir: Well K	4/27/2005	1530	N/A	N/A	7.6
Sites Reservoir: Well L	4/27/2005	1430	N/A	N/A	7.2
Sites Reservoir: Well M	6/14/2005	1030	N/A	N/A	7.2
Sites Reservoir: Well N	6/21/2005	0830	18.6	65.5	7.2
Sites Reservoir: Well O	6/21/2005	0945	N/A	N/A	7.9
Sites Reservoir: Well P	6/21/2005	1115	N/A	N/A	7.3
Funks Reservoir Well	8/28/2007	1115	23.2	73.8	7.9

Table 11A-1b. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Physical.

Water Quality Station Designator	Date Sampled	Time (PST)	EC (Field) (umhos/cm)	EC (Lab) (umhos/cm)	Alkalinity (mg/L)	Total Dissolved Solids (TDS) (mg/L at 180 degree F)
Sites Reservoir: Well A	03/24/05	1020	1490	1467	404	1011
Sites Reservoir: Well B	3/24/2005	1100	1595	N/A	496	928
Sites Reservoir: Well C	3/24/2005	1130	1598	1558	460	925
Sites Reservoir: Well D	3/24/2005	1225	2190	2160	306	1291
Sites Reservoir: Well F	4/5/2005	0915	1074	1040	239	595
Sites Reservoir: Well G	4/5/2005	0935	1335	1304	254	726
Sites Reservoir: Well H	4/5/2005	1200	680	667	232	375
Sites Reservoir: Well I	4/6/2005	1010	1190	1160	378	661
Sites Reservoir: Well J	6/7/2005	0900	778	N/A	292	509
Sites Reservoir: Well K	4/27/2005	1530	1070	1188	301	811
Sites Reservoir: Well L	4/27/2005	1430	1192	1306	456	882
Sites Reservoir: Well M	6/14/2005	1030	1312	N/A	324	811
Sites Reservoir: Well N	6/21/2005	0830	1062	N/A	352	683
Sites Reservoir: Well O	6/21/2005	0945	857	N/A	303	588
Sites Reservoir: Well P	6/21/2005	1115	965	N/A	280	656
Funks Reservoir Well	8/28/2007	1115	38200	34500	14	27400

Table 11A-2a. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Minerals.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)	Total Calcium (mg/L)	Dissolved Calcium (mg/L)	Total Magnesium (mg/L)
Sites Reservoir: Well A	03/24/05	1020	0.5	113	134	127	70
Sites Reservoir: Well B	3/24/2005	1100	1.4	359	4	4	1
Sites Reservoir: Well C	3/24/2005	1130	1.3	333	18	18	8
Sites Reservoir: Well D	3/24/2005	1225	<0.5	293	100	103	51
Sites Reservoir: Well F	4/5/2005	0915	0.5	92	92	94	24
Sites Reservoir: Well G	4/5/2005	0935	0.5	135	102	102	32
Sites Reservoir: Well H	4/5/2005	1200	1	68	58	56	14
Sites Reservoir: Well I	4/6/2005	1010	1.6	244	6	6	2
Sites Reservoir: Well J	6/7/2005	0900	1.2	115	54	53	17
Sites Reservoir: Well K	4/27/2005	1530	1.3	129	78	88	41
Sites Reservoir: Well L	4/27/2005	1430	2.4	164	89	96	38
Sites Reservoir: Well M	6/14/2005	1030	0.5	149	97	93	52
Sites Reservoir: Well N	6/21/2005	0830	2.7	147	58	55	31
Sites Reservoir: Well O	6/21/2005	0945	<0.5	63	82	79	42
Sites Reservoir: Well P	6/21/2005	1115	<0.5	71	88	73	39
Funks Reservoir Well	8/28/2007	1115	13.3	5770	2900	2920	24

Table 11A-2b. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Minerals.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Magnesium (mg/L)	Dissolved SO4 (mg/L)	Dissolved Chloride (mg/L)	Dissolved Nitrate (mg/L)	Total Dissolved Solids (mg/L)
Sites Reservoir: Well A	03/24/05	1020	73	398	38	16.1	1011
Sites Reservoir: Well B	3/24/2005	1100	2	108	143	<0.1	928
Sites Reservoir: Well C	3/24/2005	1130	8	154	163	<0.1	925
Sites Reservoir: Well D	3/24/2005	1225	58	305	365	15.6	1291
Sites Reservoir: Well F	4/5/2005	0915	25	76	133	7.2	595
Sites Reservoir: Well G	4/5/2005	0935	32	147	163	7.4	726
Sites Reservoir: Well H	4/5/2005	1200	14	31	51	7.4	375
Sites Reservoir: Well I	4/6/2005	1010	2	15	136	<1	661
Sites Reservoir: Well J	6/7/2005	0900	17	69	40	33	509
Sites Reservoir: Well K	4/27/2005	1530	46	338	18	0.2	811
Sites Reservoir: Well L	4/27/2005	1430	41	270	14	0.9	882
Sites Reservoir: Well M	6/14/2005	1030	50	133	184	0.1	811
Sites Reservoir: Well N	6/21/2005	0830	29	19	169	<0.1	683
Sites Reservoir: Well O	6/21/2005	0945	41	177	15	8.2	588
Sites Reservoir: Well P	6/21/2005	1115	32	231	27	2.4	656
Funks Reservoir Well	8/28/2007	1115	22	<1	15200	<0.1	27400

Table 11A-2c. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Minerals.

Water Quality Station Designator	Date Sampled	Time (PST)	Total Hardness (mg/L as CaCO₃)	Dissolved Hardness (mg/L as CaCO₃)	Dissolved Boron (mg/L)	Dissolved Bicarbonate (HCO₃⁻) (mg/L as CaCO₃)
Sites Reservoir: Well A	03/24/05	1020	623	618	0.6	402
Sites Reservoir: Well B	3/24/2005	1100	18	18	2	478
Sites Reservoir: Well C	3/24/2005	1130	78	78	1.6	449
Sites Reservoir: Well D	3/24/2005	1225	460	496	0.7	306
Sites Reservoir: Well F	4/5/2005	0915	329	338	0.1	239
Sites Reservoir: Well G	4/5/2005	0935	387	387	0.3	254
Sites Reservoir: Well H	4/5/2005	1200	203	198	0.2	232
Sites Reservoir: Well I	4/6/2005	1010	23	23	1.5	374
Sites Reservoir: Well J	6/7/2005	0900	205	202	0.7	291
Sites Reservoir: Well K	4/27/2005	1530	364	409	0.6	300
Sites Reservoir: Well L	4/27/2005	1430	379	409	0.7	455
Sites Reservoir: Well M	6/14/2005	1030	456	438	0.4	323
Sites Reservoir: Well N	6/21/2005	0830	273	257	0.3	351
Sites Reservoir: Well O	6/21/2005	0945	378	366	0.3	298
Sites Reservoir: Well P	6/21/2005	1115	380	314	0.3	280
Funks Reservoir Well	8/28/2007	1115	7340	7380	9.2	14

Table 11A-2d. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Minerals.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Carbonate (CO₃-) (mg/L as CaCO₃)	Dissolved Hydroxide (OH-) (mg/L as CaCO₃)
Sites Reservoir: Well A	03/24/05	1020	2	<1
Sites Reservoir: Well B	3/24/2005	1100	20	<1
Sites Reservoir: Well C	3/24/2005	1130	12	<1
Sites Reservoir: Well D	3/24/2005	1225	<1	<1
Sites Reservoir: Well F	4/5/2005	0915	<1	<1
Sites Reservoir: Well G	4/5/2005	0935	<1	<1
Sites Reservoir: Well H	4/5/2005	1200	<1	<1
Sites Reservoir: Well I	4/6/2005	1010	5	<1
Sites Reservoir: Well J	6/7/2005	0900	1	<1
Sites Reservoir: Well K	4/27/2005	1530	1	<1
Sites Reservoir: Well L	4/27/2005	1430	1	<1
Sites Reservoir: Well M	6/14/2005	1030	1	<1
Sites Reservoir: Well N	6/21/2005	0830	1	<1
Sites Reservoir: Well O	6/21/2005	0945	5	<1
Sites Reservoir: Well P	6/21/2005	1115	1	<1
Funks Reservoir Well	8/28/2007	1115	<1	<1

Table 11A-3. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Nutrients.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Ammonia (mg/L as N)	Dissolved Nitrite plus Nitrate (mg/L as N)	Dissolved Orthophosphate (mg/L as P)	Total Phosphorus (mg/L)
Sites Reservoir: Well A	03/24/05	1020	<0.01	0.44	0.02	0.02
Sites Reservoir: Well B	3/24/2005	1100	0.64	<0.01	0.05	0.06
Sites Reservoir: Well C	3/24/2005	1130	0.56	<0.01	0.03	0.05
Sites Reservoir: Well D	3/24/2005	1225	<0.01	3.4	0.01	0.01
Sites Reservoir: Well F	4/5/2005	0915	<0.01	1.7	0.02	0.02
Sites Reservoir: Well G	4/5/2005	0935	<0.01	3.1	0.02	0.02
Sites Reservoir: Well H	4/5/2005	1200	<0.01	1.5	0.01	0.02
Sites Reservoir: Well I	4/6/2005	1010	0.37	<0.01	<0.01	0.02
Sites Reservoir: Well J	6/7/2005	0900	0.02	6.42	0.01	<0.01
Sites Reservoir: Well K	4/27/2005	1530	0.04	0.05	0.06	0.08
Sites Reservoir: Well L	4/27/2005	1430	0.29	0.27	<0.01	0.01
Sites Reservoir: Well M	6/14/2005	1030	0.77	<0.01	0.05	0.08
Sites Reservoir: Well N	6/21/2005	0830	0.04	0.02	0.18	0.28
Sites Reservoir: Well O	6/21/2005	0945	<0.01	1.39	0.02	0.03
Sites Reservoir: Well P	6/21/2005	1115	<0.01	0.53	0.02	0.01
Funks Reservoir Well	8/28/2007	1115	5.8	0.02	<0.01	<0.01

Table 11A-4a. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Trace Elements.

Water Quality Station Designator	Date Sampled	Time (PST)	Total Aluminum (µg/L)	Dissolved Aluminum (µg/L)	Total Arsenic (µg/L)	Dissolved Arsenic (µg/L)	Total Cadmium (µg/L)
Sites Reservoir: Well A	03/24/05	1020	0.57	0.5	0.618	0.322	0.03
Sites Reservoir: Well B	3/24/2005	1100	41.8	15.2	0.57	0.547	0.031
Sites Reservoir: Well C	3/24/2005	1130	21.1	7.89	0.571	0.543	0.02
Sites Reservoir: Well D	3/24/2005	1225	0.63	0.58	1.51	1.43	0.081
Sites Reservoir: Well F	4/5/2005	0915	1.29	0.76	0.774	0.698	0.02
Sites Reservoir: Well G	4/5/2005	0935	1.09	1	0.853	0.801	0.019
Sites Reservoir: Well H	4/5/2005	1200	1.72	1.06	0.509	0.466	0.013
Sites Reservoir: Well I	4/6/2005	1010	1.98	1.56	0.486	0.458	<0.009
Sites Reservoir: Well J	6/7/2005	0900	1.56	1.23	0.442	0.422	0.165
Sites Reservoir: Well K	4/27/2005	1530	4.8	1.07	0.528	0.509	0.109
Sites Reservoir: Well L	4/27/2005	1430	12.5	0.98	0.284	0.259	0.093
Sites Reservoir: Well M	6/14/2005	1030	<1.16	0.8	1.26	0.873	<0.009
Sites Reservoir: Well N	6/21/2005	0830	1.37	1.06	2.63	2.02	<0.012
Sites Reservoir: Well O	6/21/2005	0945	<1.16	0.8	0.579	0.563	<0.012
Sites Reservoir: Well P	6/21/2005	1115	89	10.8	0.326	0.278	0.144
Funks Reservoir Well	8/28/2007	1115	32.1	2.5	87.7	80.9	<0.1

Table 11A-4b. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Trace Elements.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Cadmium (µg/L)	Total Chromium (µg/L)	Dissolved Chromium (µg/L)	Total Copper (µg/L)	Dissolved Copper (µg/L)
Sites Reservoir: Well A	03/24/05	1020	0.029	4.08	4	3.16	2.54
Sites Reservoir: Well B	3/24/2005	1100	<0.022	4.47	3.71	0.71	0.69
Sites Reservoir: Well C	3/24/2005	1130	<0.022	4.98	3.9	4.97	4.17
Sites Reservoir: Well D	3/24/2005	1225	0.081	7.14	5.53	4.21	4.02
Sites Reservoir: Well F	4/5/2005	0915	<0.022	5.68	5.6	0.45	0.44
Sites Reservoir: Well G	4/5/2005	0935	<0.022	5.31	5	11.4	11.1
Sites Reservoir: Well H	4/5/2005	1200	<0.022	2.93	2.23	16.2	10.5
Sites Reservoir: Well I	4/6/2005	1010	<0.022	4.53	3.94	0.21	0.14
Sites Reservoir: Well J	6/7/2005	0900	<0.027	2.48	2	1.19	1
Sites Reservoir: Well K	4/27/2005	1530	0.073	1.86	1.05	1.77	1.2
Sites Reservoir: Well L	4/27/2005	1430	<0.029	3.01	0.06	1.48	1.43
Sites Reservoir: Well M	6/14/2005	1030	<0.009	0.69	0.6	0.84	0.56
Sites Reservoir: Well N	6/21/2005	0830	<0.009	0.65	0.6	1.18	0.59
Sites Reservoir: Well O	6/21/2005	0945	<0.009	1.03	0.6	1.33	1.12
Sites Reservoir: Well P	6/21/2005	1115	0.013	0.74	0.34	1.51	0.96
Funks Reservoir Well	8/28/2007	1115	<1	5.6	5	8.34	4.6

Table 11A-4c. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Trace Elements.

Water Quality Station Designator	Date Sampled	Time (PST)	Total Iron (µg/L)	Dissolved Iron (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)	Total Manganese (µg/L)
Sites Reservoir: Well A	03/24/05	1020	<3.58	<5.67	0.072	0.048	0.31
Sites Reservoir: Well B	3/24/2005	1100	43	<5.67	0.163	0.069	8.81
Sites Reservoir: Well C	3/24/2005	1130	335	38.1	0.256	0.201	23.3
Sites Reservoir: Well D	3/24/2005	1225	<3.58	<5.67	0.235	0.164	0.24
Sites Reservoir: Well F	4/5/2005	0915	<3.58	<5.67	0.093	0.078	0.15
Sites Reservoir: Well G	4/5/2005	0935	<3.58	<5.67	0.259	0.194	1.46
Sites Reservoir: Well H	4/5/2005	1200	<3.58	<5.67	0.264	0.177	0.22
Sites Reservoir: Well I	4/6/2005	1010	<3.58	<5.67	0.099	0.09	10.2
Sites Reservoir: Well J	6/7/2005	0900	<1.08	<3.2	0.528	0.52	0.45
Sites Reservoir: Well K	4/27/2005	1530	10.4	<3.18	0.099	0.086	41.5
Sites Reservoir: Well L	4/27/2005	1430	388	<3.18	0.112	0.02	52.2
Sites Reservoir: Well M	6/14/2005	1030	11.5	<3.68	<0.027	<0.009	39.7
Sites Reservoir: Well N	6/21/2005	0830	227	41	<0.027	<0.009	125
Sites Reservoir: Well O	6/21/2005	0945	<3.3	<3.68	<0.027	<0.009	0.09
Sites Reservoir: Well P	6/21/2005	1115	183	<3.68	1.85	0.12	5.98
Funks Reservoir Well	8/28/2007	1115	162	23.2	0.659	0.6	809

Table 11A-4d. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Trace Elements.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Manganese (µg/L)	Total Mercury (µg/L)	Total Nickel (µg/L)	Dissolved Nickel (µg/L)	Total Selenium (µg/L)
Sites Reservoir: Well A	03/24/05	1020	0.22	0.35	4.02	4.01	8.28
Sites Reservoir: Well B	3/24/2005	1100	2	0.61	0.22	0.16	2.87
Sites Reservoir: Well C	3/24/2005	1130	18.1	0.25	0.59	0.43	3.17
Sites Reservoir: Well D	3/24/2005	1225	0.15	0.55	2.04	2	25.6
Sites Reservoir: Well F	4/5/2005	0915	0.06	0.28	0.24	0.14	3.87
Sites Reservoir: Well G	4/5/2005	0935	1.37	0.41	0.41	0.31	4.84
Sites Reservoir: Well H	4/5/2005	1200	0.13	0.37	0.16	0.16	3.82
Sites Reservoir: Well I	4/6/2005	1010	10	<0.15	0.13	0.1	2.88
Sites Reservoir: Well J	6/7/2005	0900	0.33	0.19	0.9	0.9	3.61
Sites Reservoir: Well K	4/27/2005	1530	40.1	0.22	1.57	1.07	2.94
Sites Reservoir: Well L	4/27/2005	1430	51.3	1.24	1.99	1.88	1.67
Sites Reservoir: Well M	6/14/2005	1030	33	1.58	1.84	1.12	3.14
Sites Reservoir: Well N	6/21/2005	0830	107	1.09	1.83	1.23	1.32
Sites Reservoir: Well O	6/21/2005	0945	0.08	0.26	1.37	0.59	1.84
Sites Reservoir: Well P	6/21/2005	1115	2.72	1.14	1.58	1.46	5.55
Funks Reservoir Well	8/28/2007	1115	721	N/A	16	13.8	2.29

Table 11A-4e. North of Delta Offstream Storage Primary Study Area Groundwater Quality Study Results - Trace Elements.

Water Quality Station Designator	Date Sampled	Time (PST)	Dissolved Selenium (µg/L)	Total Silver (µg/L)	Dissolved Silver (µg/L)	Total Zinc (µg/L)	Dissolved Zinc (µg/L)
Sites Reservoir: Well A	03/24/05	1020	8.08	0.013	<0.003	748	737
Sites Reservoir: Well B	3/24/2005	1100	2.55	<0.005	<0.003	2.26	1.52
Sites Reservoir: Well C	3/24/2005	1130	2.55	<0.005	<0.003	2.78	0.92
Sites Reservoir: Well D	3/24/2005	1225	25.3	0.026	0.014	478	471
Sites Reservoir: Well F	4/5/2005	0915	3.58	<0.005	<0.003	0.43	0.39
Sites Reservoir: Well G	4/5/2005	0935	3.69	<0.005	<0.003	4.08	3.54
Sites Reservoir: Well H	4/5/2005	1200	3.45	<0.005	<0.003	12.6	11.3
Sites Reservoir: Well I	4/6/2005	1010	2.19	<0.005	<0.003	<0.258	0.04
Sites Reservoir: Well J	6/7/2005	0900	2.95	<0.015	<0.009	128	127
Sites Reservoir: Well K	4/27/2005	1530	2.9	<0.027	<0.009	75.2	65.3
Sites Reservoir: Well L	4/27/2005	1430	1.31	<0.027	<0.009	20.8	19.9
Sites Reservoir: Well M	6/14/2005	1030	2.15	<0.027	<0.002	3.59	3.08
Sites Reservoir: Well N	6/21/2005	0830	1.09	<0.027	<0.002	0.94	0.81
Sites Reservoir: Well O	6/21/2005	0945	1.01	<0.027	<0.002	42.1	41.4
Sites Reservoir: Well P	6/21/2005	1115	5.5	<0.027	<0.002	209	204
Funks Reservoir Well	8/28/2007	1115	<2	<0.03	<0.3	3.9	2.6